Evaluating Xen, VMware, and OpenVZ Virtualization Platforms for Network Virtualization

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***Abstract*—Network virtualization is a technique that allows having multiple concurrent isolated networks sharing physical network resources. This work analyzes the main available virtualization platforms, Xen, OpenVZ, and VMware, for network virtualization. We compare their virtualization techniques, achieved performance in virtualizing computational resources and appropriateness for usage in a virtual network environment. To achieve our goal, we conduct experiments to evaluate overhead introduced by the virtualization platforms in comparison to a non-virtualized environment.**

I. Overview

There has been recently great interest in network virtualization, since it is considered a main component in many proposals for future internet architectures [1]. Network virtualization grants the ability to run concurrent virtual networks using independent network stacks, adding flexibility to the network. In order to implement network virtualization, a virtualization platform must be used. There are three main components in a virtual environment: (i) the virtualized substrate, which holds the shared resources, (ii) the virtualization layer, a software layer that runs on top of the virtualized substrate and is responsible for sharing the resources, and the (iii) virtual slices, which present an interface similar to the real substrate interface. In this work we evaluate Xen, VMware, and OpenVZ virtualization platforms.

Xen [2]is a virtualization platform designed for commodity-hardware virtualization. Thus, the virtualized substrate is a computer hardware and the virtual slices are called virtual machines. Xen uses the paravirtualization technique. In paravirtualization, the Operating System (OS) inside the virtual machine is modified to be aware of virtualization, and hence processor instructions, memory management and input/output mechanisms are modified to improve the overall system performance. Applications inside the virtual machine, however, have no need to be modified. VMware [3] uses a technique known as total virtualization, in which the OS inside the virtual machine does not need to be modified and processor instructions are handled during runtime either by the virtualization layer, called hypervisor, which adds great processing overhead, or by virtualization enabled hardware, which leads to better performance. The last virtualization platform, OpenVZ [4] uses OS level virtualization. In OpenVZ, the virtualization layer is placed over the OS, providing a virtual kernel interface to virtual slices, which share the same underlying kernel. This technique reduces flexibility trading it for potentially smaller overhead.

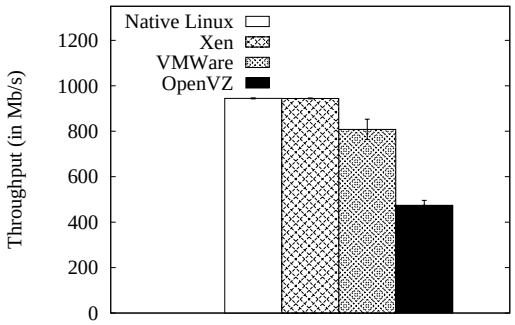

Figure 1. Network reception test using large packet size.

II. Tests

Many tests were made to evaluate overhead introduced by the virtualization tools in comparison to the non virtualized environment. Our tests focus on CPU, RAM memory access, disk access and network performance. The tests used a computer to test the virtualization tools by executing benchmarks, another computer for controlling the tests and measuring the performance and a third computer used for exchanging data with the virtualized environment for the network tests.

III. Results and Conclusions

Our results show that the evaluated virtualization platforms achieve enough performance for usage in a network environment. Fig.1 corroborates with our statement, showing that Xen can receive as much network traffic as native Linux did.

As an overall analysis, we consider Xen the best platform for network virtualization, because it provides high programmability for the virtual environment, has acceptable overhead and it is open source, allowing modifications to optimize mechanisms for network virtualization.

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